Internal Combustion Engine with Pressure Lubrication by the Dry Sump Principle

The present invention relates to an internal combustion engine with pressure lubrication according to the dry sump principle, in particular for an opposed-cylinder engine according to the preamble of Patent Claim 1.

With today's water-cooled six-cylinder opposed-cylinder engines of the 911 Carrera model series (Dr. Ing. h.c. F. Porsche AG), an oil bulkhead tank in which the oil sump for the lubricating oil supply to the engine is formed is provided in the oil carrying casing and/or in the oil pan. The oil lubricant recycled by the various consumers back to the oil pan is first returned outside of the oil bulkhead tank forming the oil suction space before entering the actual oil suction space through openings monitored by valves in the oil bulkhead tank.

In engines with dry sump lubrication, the oil flowing back into the oil pan is conveyed by a suction pump into a separate oil tank or oil supply container from which the pressure oil delivery pump sucks out the lubricant and forces it to the lubrication points through filters and oil coolers, if necessary. In most cases the oil tank is mounted on the outside of the crankcase and has corresponding connections for the oil pressure lines laid externally.

The object of the present invention is to develop a low-friction driving gear with dry sump pressure lubrication for high-speed operation in particular to increase the specific power of an internal combustion engine; in this type of operation, the components required for pressure lubrication of the internal combustion engine are largely integrated into the engine in a space-saving manner.

This object is achieved according to this invention by the features of Patent Claim 1.

According to this invention, it is proposed that a portion of the oil be recycled into the oil supply container and/or into the wet sump space through annular spaces designed around the cylinder.

Other advantages and advantageous embodiments of the present invention are derived from the dependent claims and the description.

In particular in the case of cylinder crankcases in the open-deck design in which the water jacket is provided only in the upper part of the cylinder, there remains an annular space which is open toward the crankcase space and which can be used as part of the oil return line into the wet sump with an appropriate seal at the end. A gland made of plastic, for example, may be provided as the seal for the annular space.

When the (wet sump) oil-collecting space is arranged beneath the annular spaces provided for the oil return and/or integrated into the crankcase, the lubricating oil can be transferred directly from the annular spaces into the oil-collecting space(s). It is thus possible to largely eliminate external oil lines so that this measure contributes to a compact and inexpensive implementation of an internal combustion engine with dry sump lubrication.

On the basis of the horizontal arrangement of cylinders in an opposed-cylinder engine, the annular spaces which are used for the lubricating oil return can be vented toward the top and the lubricating oil can be defoamed.

An exemplary embodiment of the present invention is illustrated in the drawing and explained in greater detail in the following description.

FIG 1 shows a dry sump oil circulation diagram of an internal combustion engine and

FIG 2 shows a basic diagram of the oil return in the area of the cylinders.

FIG 1 shows the principle of a dry sump oil circulation system, which is not limited to this embodiment, for a six-cylinder opposed-cylinder engine, the parts of which that are necessary only for a description of the oil circulation are described in greater detail below with reference to the figures. The engine has two crankcase halves 2 and 4; a cylinder bank row 1 through 3 and 4 through 6 is arranged in each half. A cylinder head 6, 8 in which the valve drive required for operating the intake and exhaust valves is arranged is connected to each of the two cylinder bank rows. Beneath the bearing for the crankshaft 10, the crankcase 2, 4 has an oil suction space 12 (dry sump) in which the oil lubricant provided for lubrication of the bearings is collected. Oil return bores (not shown) are integrated into the

engine, ensuring that the oil lubricant is returned to the oil suction space 12 in a targeted manner.

The dry sump oil suction space 12 is bordered by an oil bulkhead tank 14 with (wet sump) collecting spaces 16 and 18 adjacent to the two side walls 14a and 14b thereof. The two collecting spaces 16, 18 are interconnected by an interspace 22 which is formed between the lower wall 14c of the oil bulkhead tank 14 and an oil pan cover 20. An oil return pump 24 provided for the dry sump pressure lubrication has an oil suction line 26 connected to its intake end leading into the oil suction space 12. An oil suction snorkel 28 which is attached to the end of the oil suction line 26 is arranged in the area of the lower wall 14c of the oil bulkhead tank 14. A line 30 is connected to the pressure side of the oil return pump 24 and leads as a branch line 30a or 30b to annular spaces 32 and 34, respectively, surrounding the cylinders 1 through 3 and 4 through 6.

The two annular spaces 32, 34 are each sealed by a gasket 36 (shown only in the left crankcase half 2), e.g., in the form of a plastic gland, on the end face which faces the crank[case] space. As FIG 1 and FIG 2 show, the annular spaces 32, 34 have openings 38 and/or passages on their lower lateral surfaces that are connected to the (wet sump) collecting spaces 16, 18. The middle cylinder of each of the two cylinder bank rows 1 through 3 and 4 through 6 has a vent connection 40, 42, which is connected to the top side of the annular spaces 32, 34 (at the top in relation to the installed position of the cylinder). On the basis of this shape of the oil return, it is possible to largely omit any externally installed oil lines. The oil lubricant can be defoamed via the annular spaces 32, 34 and air and/or gas components can be discharged to the outside through the vent connections 40, 42 so that separate oil/air separators are not needed. As shown in FIG 1, the wet sump collecting spaces 16 and 18 and the dry sump oil suction space 12 are vented through appropriate lines 54, 56. Likewise annular spaces 55 are provided in the upper area of the cylinders with coolant flowing through the annular spaces to cool the cylinders and said annular spaces are separated from annular spaces 32, 34 by a peripheral web 57.

Suction pumps 44, 46 driven by the camshafts are provided in the two cylinder heads 6, 8 of the internal combustion engine, drawing the lubricant oil conveyed by a main delivery pump 48 into the cylinder heads 6, 8 and

returning it via lines 50, 52 and the annular spaces 32, 34 to the (wet sump) collecting spaces 16, 18.

The main delivery pump 48 is driven by an intermediate shaft (not shown in detail), an oil suction line 58 being connected to its intake side and leading into the oil-collecting space 16. An oil suction snorkel 60 which is placed near the oil pan cover 20 is also attached to the end of the oil suction line 58. Oil supply lines (not shown in detail here) integrated into the crankcase 2, 4 are connected to the pressure side of the main delivery pump 48 and lead to the consumers, e.g., the main bearing points of the crankshaft and the camshaft.